HERLEY New England

PROCESS SPECIFICATION
RADIATION SAFETY PROGRAM

P-503
ISSUE: C
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DOCUMENT REVISION STATUS

REVISION LEVEL	DESCRIPTION OF CHANGE	DATE	ECO #
1	SEE REVISION HISTORY ON FILE	12/94	ON FILE
2	REVISED TO CONFORM TO ECN REQUIREMENT.	7/00	12890
A	REWROTE PROCEDURE PER ECN.	7/18/07	14659
B	REVISED SECTION 1.0 & 3.4.1 AND FIGURES 1 & 2. SEE ECO.	8/3/10	15306
C	REVISED PER ECO.	8/3/10	15339

APPROVALS

APPROVED: RADIATION SAFETY OFFICER: _____ DATE: 9/22/10

APPROVED: PROCESS ENGINEERING: _____ DATE: 9-22-10

APPROVED: ENGINEERING MANAGER: _____ DATE: 9/21/10

APPROVED: MANUFACTURING MANAGER: _____ DATE: 9/21/10

APPROVED: QUALITY ASSURANCE MANAGER: _____ DATE: 9/21/10

1.0 INTRODUCTION:

Herley New England (a division of Herley, Inc.) designs and manufactures custom microwave products at 10 Sonar Drive in Woburn Massachusetts. The 55,000 square foot facility includes a 5,500 square foot Class 100,000 clean room that meets all the requirements of FED-STD-209.

The primary use of radioactive materials is limited to two restricted areas denoted in Figure 1 as R1 and R2. Radiolabled sources are sent to lab space denoted on the reference map as LS1 for final assembly and quality assurance. The final device is sent to shipping/receiving for packaging and shipment. Primary waste storage is indicated in Figure 2 as WS.

Specifically, radioactive materials are used for the manufacturing of electron tubes and for the distribution or transfer to persons authorized to receive the licensed material pursuant to the terms and conditions of a specific license issued by the Nuclear Regulatory Commission or an Agreement State.

RADIOACTIVE MATERIALS	CHEMICAL/PHYSICAL FORM	MAXIMUM POSSESSION LIMIT
Hydrogen-3 (3-H)	Any Form Titanium Tritide Plated on Copper	100 Curies 300 Curies
Cobalt-60 (60-Co)	Any Form	800 microCuries
Promethium-147 (147-Pm)	Any Form	15 milliCuries

2.0 SCOPE:

This document describes the procedures for safe receipt, storage, handling and shipment of radioactive materials. This document also addresses the annual radioactive safety review of all documents and policies of this program. All radioactive materials are stored and handled in a closed-off restricted area. Access to this restricted area is prohibited to unauthorized personnel. Authorized personnel are listed on the Radiation Roster which is maintained by the Herley New England Radiation Safety Officer (RSO).

2.1 ASSOCIATED DOCUMENTS:

The following is a list of procedures and reference documents used by Herley New England for the safe possession and use of radioactive materials.

Internal Reference Documents:

P-014 – Radioactive (RA) By-Product Material Application – Tritium
P-012 – Radioactive (RA) By-Product Material Application – Cobalt
P-052 – Radioactive (RA) By-Product Material Application – Promethium 147
P-255 – Procedures for Disposal of Radioactive Waste
P-504 – Manufacturing Procedure for Decontamination of Restricted and Non-Restricted Areas

2.1 ASSOCIATED DOCUMENTS: (cont.)

Radiation Safety Procedures:

P-664 – Emergency Response Procedures
P-671 – General Rules for the Safe Use of Radioactive Materials
P-672 – Ordering and Receipt of Radioactive Materials
P-673 – Processing of Received Radioactive Materials Package
P-674 – Radiation and Contamination Survey Procedures
P-675 – Operational Bioassay Procedures
P-676 – Procedures for the Packaging and Shipment of Devices Containing Radioactive Materials
P-681 – BetaScout Operational Instructions

3.0 PROGRAM DESCRIPTION:

3.1 Radiation Safety Officer (RSO)

The Radiation Safety Officer is responsible for maintaining compliance with all state and federal regulations. This person is also expected to keep any exposures of Herley New England employees and members of the public as low as reasonably achievable (ALARA).

During periods when the RSO is not present certain tasks may be delegated to an Assistant RSO or other designated individual(s) whose training and experience has been determined by the RSO to be adequate to perform those tasks. A record of these individuals will be maintained by the RSO. Quarterly reviews of any records generated by these individuals will be conducted and maintained by the RSO. However, this does not relieve the RSO from the overall responsibility for assuring that all operations are in accordance with the terms and conditions of the radioactive material license and the Massachusetts Regulations for the Control of Radiation (MRCR).

Duties and responsibilities of the RSO are listed in Appendix A.

3.1.1 Annual Safety Review:

It is required that an annual review of all procedures and policies regarding the handling and processing of radioactive materials and by-products be conducted by an outside consultant with the aid of the RSO.

3.2 Training

In general, employees working with or frequenting areas where radioactive materials are used, stored or processed will receive radiation safety training upon start of employment and a refresher annually thereafter. Training will be, at a minimum, commiserate with the level of potential exposure.

Individuals can use radioactive materials only after receiving proper training. This training may be received by attending Radiation Training Seminars offered by Herley New England or by other equivalent courses as approved by the RSO.

3.2 Training: (cont.)

Individuals using radioisotopes under a Commonwealth of MA license have certain rights as prescribed in MRCR 120.750, "Notices, Instructions and Reports to Workers; Inspections". In accordance with this section, Herley New England posts current copies of the following documents (or a notice which describes the documents and states where they can be examined) in those areas where work is being done:

3.2.1 Form MCRP 120.750-1, "Notice to Employees"
3.2.2 Notices of violation involving radiological working conditions, proposed impositions of civil penalties, or orders from the MRCP.

The RSO is in charge of radiation safety training and will either personally conduct the Radiation Safety Training Seminar or have it taught by an independent outside consultant. Specific topics covered during training can be found in Appendix B.

3.3 Dose Control

3.3.1 Definitions

Deep Dose Equivalent (DDE) = The external dose equivalent at a tissue depth of 1cm and applies to external whole body exposure.

Lens of the Eye Dose Equivalent (LDE) = The external dose equivalent to the lens of the eye at a tissue depth of 0.3cm.

Shallow Dose Equivalent (SDE) = The dose equivalent at a tissue depth of 0.007cm ($7mg/cm^2$) averaged over an area of one square centimeter applicable to the external exposure of the skin or an extremity.

Committed Dose Equivalent (CDE) = The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50 year period following the intake.

Committed Effective Dose Equivalent (CEDE) = The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

Total Effective Dose Equivalent (TEDE) = The sum of the DDE for external exposures and the CEDE for internal exposures.

3.3.1 Annual Occupational Dose Limits for Adult Workers

Herley New England controls exposures to occupationally exposed adults so that no individual will receive in any one calendar year, a dose in excess of the following limits:

TEDE = 5rem
DDE+CDE to any individual organ or tissue = 50rem
LDE = 15rem
SDE = 50rem to the skin or any extremity

3.3.2 Dose Limits to Declared Pregnant Workers

Herley New England controls exposures to the embryo/fetus of Declared Pregnant Workers by limiting doses to the women to 0.5rem during the gestation period and ensuring that doses are distributed uniformly during the gestation period. Women wishing to declare pregnancy must do so in accordance with 105 CMR 120.203.

3.3.3 Dose Limits to Members of the General Public

Operations involving the use of radioactive material at Herley New England are controlled so that doses to the maximally exposed members of the public are maintained below 0.1rem in any one calendar year.

3.4 Personal Monitoring

3.4.1 Film Badges

Herley New England requires all personnel entering Restricted Areas (RA1 or RA2) to wear film badges. All personnel are monitored in accordance with regulations in 105 CMR 120.226(A). Badges are supplied and analyzed monthly by R.S. Landauer, Jr. & Co., 2 Science Road, Glenwood, IL, 60425-1586 or by any other equivalent NVLAP approved dosimetry service. Monitoring reports are returned to the RSO, who reviews them to assure that exposures are maintained within acceptable levels. Personnel monitoring dosimetry will always be performed by a NVLAP certified group.

3.4.2 Bioassays

Herley New England requires all personnel working with 10 millicuries or more of tritium (Hydrogen-3) to submit a urine sample for analysis on a bi-weekly basis. Analysis is performed by an approved outside consultant.

Collection requirements and action levels are outlined in Herley New England procedure P-675.

3.5 Surveys and Monitoring

3.5.1 Instrumentation

3.5.1.1 Survey Meters

Herley New England currently has two survey instruments available for radiation level monitoring. The specifications of the instruments can be found on the next page.

3.5.1.1 Survey Meters: (cont.)

	Instrument 1	Instrument 2
Manufacturer:	Ludlum	Ludlum
Model Number:	Model 2-001R	Model 3
Serial Number:	22381	215849
Probe Type:	GM	GM
Probe Model Number:	Ludlum 44-38	Ludlum 44-38
Probe Serial Number:	22381(1)	PR-229000

Survey instruments are sent out for recalibration annually. Instruments are never sent out at the same time for recalibration except when a loaner instrument is available for use. Recalibration is only performed by an approved vendor.

Daily check out procedures for the radiation survey and instruments are found in Appendix C.

3.5.1.2 Liquid Scintillation Counter

Herley New England uses a BetaScout Liquid Scintillation Counter for routine wipe test evaluation.

Manufacturer: Hidex-Oy
Model Number: 2007-0010
Serial Number: 20070065

BetaScout LSC is used to evaluate daily wipe test samples, provide material is used that day. It is also used to wipe test hermetically-sealed devices made in the Restricted Areas and final device and packages for shipments.

The BetaScout is sent out for recalibration annually. During recalibration period, wipe tests are collected and processed by an approved outside vendor.

Proper use of the BetaScout LSC is outlined in Herley New England procedure P-681.

3.5.2 Radiation and Contamination Surveys

Routine radiation and/or contamination surveys of restricted areas are performed as appropriate (e.g. radiation surveys are not appropriate for H-3 uses). Radiation surveys are performed on a weekly basis and recorded. Contamination surveys are also

3.5.2 Radiation and Contamination Surveys: cont.)

performed weekly and recorded. All surveys will be conducted by the RSO or designee in conjunction with an approved independent consultant.

Results from wipe tests in restricted areas must be less than 5000dpm/100cm^2 (unrestricted areas 1000dpm/100cm^2). If levels are found to be higher than these limits, the area must be decontaminated and re-surveyed until counts fall below these limits.

All radiation survey reports will be maintained by the RSO for inspection by the Commonwealth of Massachusetts Radiation Control Program.

Proper procedures for area surveys are found in Herley New England procedure P-674.

3.5.1 Airborne Releases

Air effluent releases for tritium (Hydrogen-3) are checked on a quarterly basis by air sampling. Air sampling and subsequent evaluation is done by an approved outside consultant. Results of measurements are reviewed by the RSO and logged. If an excess air release is indicated (10% of the DAC ($1x10^{-7}$ µCi/mL (Hydrogen-3))) an investigation shall be initiated and corrective action taken immediately.

3.5.2 Sealed Source Inventory and Wipe Testing

Herley New England does not possess any sealed sources that require bi-annual leak testing and quarterly inventory.

Wipe testing is performed by the RSO or designee on the final hermetically-sealed devices created in the Restricted Areas (RA1 and RA2). If leak testing indicates contamination above 2 times background corrective action is taken. Corrective action involves decontamination and re-wipe testing of the device.

3.6 Storage and Control

The RSO shall ensure that Restricted Areas are locked when left unattended such that radioisotopes are stored securely and access is controlled. All radioisotopes stored or used in a restricted area shall be constantly attended by a user and secured from unauthorized removal.

3.7 Postings

Each area and room where radioisotopes are stored shall be posted with a "Caution – Radioactive Material" sign. Radiation levels around storage areas must be measured. If radiation doses exceed five (5) millirem per hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates into an area accessible to individuals, the area must be posted with a "Caution – Radiation Area" sign.

3.8 Ordering and Receipt of Radioactive Materials

Orders for radioactive materials are generated by the RSO. In the absence of the RSO, a designee may be appointed to place orders. All orders for radioactive materials must not exceed limits set in Herley New England's license. It is the RSO's responsibility to maintain an inventory of all radioactive material present on-site at all times.

Radioactive materials are received at the following address:

Herley New England
A Division of Herley, Inc.
10 Sonar Drive
Woburn, MA 01801

Attention: Radiation Safety Officer

Processing of received radioactive materials is outlined in Herley New England procedures P-672 & P-673.

3.9 Waste Disposal

Waste is divided into two categories; Long-lived Dry/Solid and LSV. All radioisotopes used at Herley New England are long-lived and not subject to Storage for Decay treatment. Material is held on site in locations WS (see Figure 2).

Herley New England's waste management plan is formulated to comply with the regulations in 105 CMR 120.890. The plan is devised to minimize any waste due to this operation. Conduct of this program in accordance with this plan has consistently resulted in well less than $100ft^3$ of waste per year.

3.10 Emergency Procedures

A radiation emergency has occurred when a set of circumstances results in hazardous radiation levels, hazardous concentrations of airborne radioisotopes or gross contamination of property. Examples of radiation emergencies are:

3.10.1 Personnel Contamination
3.10.2 Fire in a radioisotope area
3.10.3 Release of airborne radioactive material

Emergency Response Procedures, describing the actions to take in the event of an emergency involving radioactive material, can be found in Herley New England procedure P-664.

FIGURE 1: First Floor Map

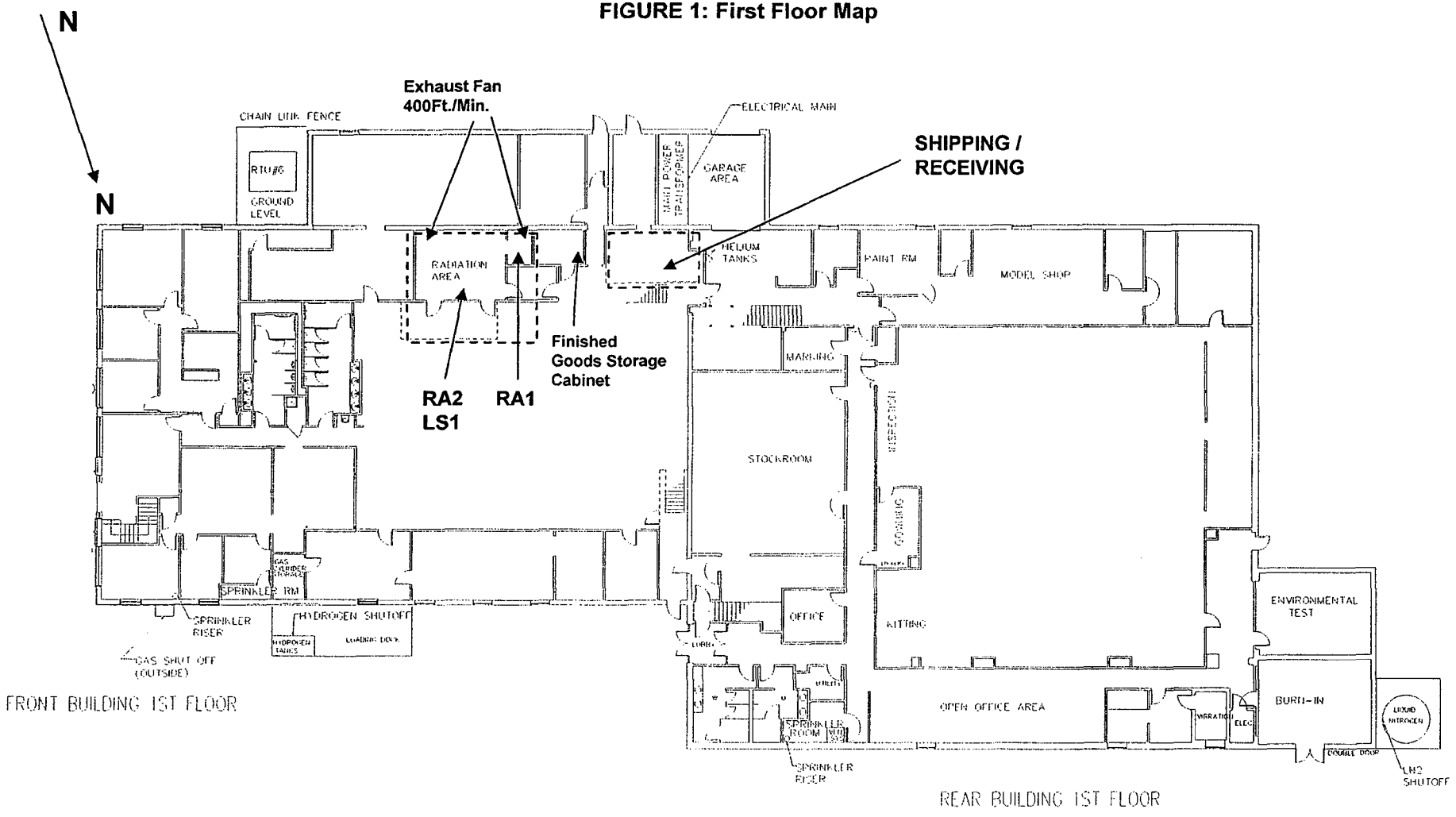
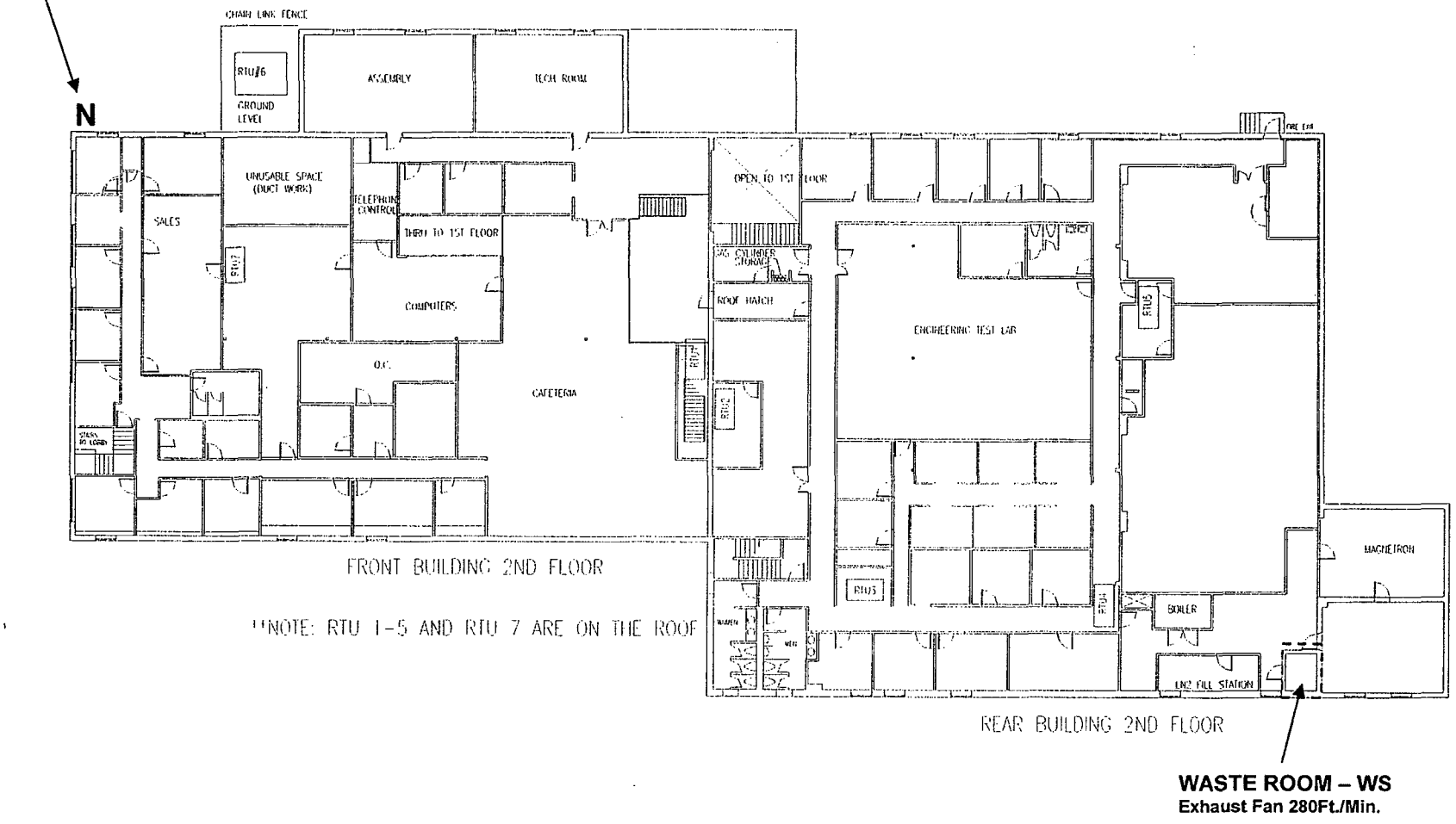


FIGURE 2: Second Floor Map



HERLEY NEW ENGLAND

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APPENDIX A

RADIATION SAFETY OFFICER DUTIES AND RESPONSIBLITIES

- To assure that all procedures that are set up to handle RA materials are maintained and to review on a regular basis with cognizant personnel, their daily work habits regarding personal safety.
- To assure that all records are kept up to date and to initiate action when necessary.
- To instruct personnel on proper handling techniques along with interpreting applicable documents.

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APPENDIX B

RADIATION SAFETY TRAINING OUTLINE

Training shall include but not be limited to the following topics:

I. Fundamentals of Radiation Safety
   a. Characteristics of radiation
   b. Units of radiation dose and quantity of radioactivity
   c. Math and calculations basic to the use and measurement of radioactivity
   d. Significance of radiation dose
   e. Radiation protection standards
      i. The ALARA principle
      ii. Biological effects of radiation
      iii. Levels of radiation from sources of radiation

II. Methods of controlling radiation dose
   a. Working time
   b. Working distance
   c. Shielding

III. Radiation Detection Instrumentation to be Used
   a. Use of radiation survey instruments
      i. Operation
      ii. Calibration
      iii. Limitations
   b. Survey techniques
   c. Use of personnel monitoring equipment
      i. Film badges
      ii. Thermoluminescent dosimeters (TLD's)
      iii. Bioassays

IV. Safety Equipment to be Used
   a. Remote handling equipment
   b. Fume hoods
   c. Storage containers
   d. Security
   e. Personnel protective equipment (i.e. gloves, lab coats, respirators)

V. The Requirements of Pertinent Federal and State Regulations

VI. Terms and Conditions of the License, Active Amendments and Any Correspondence Submitted in Support of the License Application.

VII. The Requirements of Herley New England Radiation Use Procedures.

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APPENDIX C

DAILY CHECK-OUT PROCEDURES FOR RADIATION SURVEY INSTRUMENTS

This procedure applies to either Instrument 1 or 2.

1.0 Check Calibration Date

1.1 Date must be within 1 year of date of survey.

2.0 Check Battery

2.1 Turn rotary switch to battery.
2.2 The check battery level on the meter must be 3.5 or better for proper operation.

3.0 Testing the Survey Meter

3.1 Turn the selector switch to the X10 position.
3.2 Expose the detector to the check source.
3.2.1 The detector should click with the audio on-off switch set to "on".
3.3 Rotate the selector switch through the lower scales until a meter reading is indicated.
3.3.1 Response of the instrument must be within ±10% of the expected readings.
3.4 The toggle switch marked F-S should have the fast response in "F" and slow response in "S". Depress the reset switch. The meter should zero.

4.0 Check Background

If the instrument passes all of these tests, the instrument is ready for use.

LUDLUM MODELS' 2 &3 SURVEY METER
LOG SHEET

DATE	*TIME AM/PM*	*OPERATOR*	*METER #*	*CAL DATE*	*NOTES*

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APPENDIX 1

REGULATIONS GOVERNING THE USE OF SOURCES OF IONIZING RADIATION

AUTHORIZATION

No one may use, bring into or remove from the company any radioisotopes without authorization from the RSO. Every individual working with radioisotopes or in the radiation controlled areas must be registered with the RSO.

TRAINING

No individual may work with radioisotopes without training and indoctrination necessary to ensure safe working habits, to prevent the exposure of others and to avoid contamination of the surroundings.

RESPONSIBILITIES

Work with radioisotopes must be done in accordance with regulations issued by the RSO and available from that office.

These regulations cover maximum exposure limits, posting of areas, monitoring procedures, procurement, delivery, storage, waste disposal, records transportation, protective clothing, contamination, work habits and procedures, accidents and termination of work.

NOTIFICATION OF ENVIRONMENTAL HEALTH & SAFETY

RSO shall be notified promptly of all accidents involving possible personnel and area contamination, over exposure to radiation, spread of contamination, difficulty in cleaning up a contaminated area and of any violations or unsafe practices with radioactive material.

RSO must also be notified in the event of loss or misplacement of radioisotopes and sources.

RULES FOR EFFECTIVE RADIATION PROTECTION

1. Avoid all unnecessary exposure to ionizing radiation.
2. Keep external radiation exposure to a minimum by planning your work habits with minimum exposure in mind. Do not linger unnecessarily in radiation areas. Use remote handling tools and shielding for significant sources.
3. Keep the chances of ingestion or skin contamination and penetration to a minimum through the use of appropriate protective clothing, including gloves. Never work without gloves if there is a break in the skin below the wrist.
4. Wear film badges in restricted areas.
5. Do not pipette by mouth.
   Do not store or eat food in rooms where work with unsealed radioactive material is taking place. Do not smoke while working with unsealed radioactive materials or in contaminated areas.
6. Wash hands when operations are completed. Monitor hands, clothing and work area and record results even if negative.
7. Keep yourself informed of all safety measures pertaining to your work, including the appropriate corrective action in the event of an accident.
8. Secure all sources against unauthorized remove.
9. In the event of a spill or accidental release:

   Restrict access to restricted area.
   Prevent spread of contamination.
   Notify RSO.

10. Dispose of any contaminated material in radioactive waste barrels.

CONTACT RADIATION SAFETY OFFICER WHENEVER QUESTIONS ARISE CONCERNING A RADIATION HAZARD OR PROPER PRACTICE IN WORKING WITH RADIOACTIVE MATERIAL.

In accordance with the provisions of the Code of Federal Regulations, title 10, part 19, section II, Employees are notified that copies of the NRC by-product materials license and amendments issued to the RSO, the NRC regulations in 10 CFR 19 and 20 are available from examination through the RSO.

Herley New England, a division of
Herley Industries, Inc.
10 Sonar Drive
Woburn, MA 01801
Tel. (781) 729-9450

In accordance with the provisions of the Department of Public Health Radiation Control Program the State of Massachusetts has adopted regulations in 105 CMR 120.200 which establish standards for the protection against radiation hazards. Title 105 CMR 120.750 the agency has also established certain provisions for the options of workers engaged in work under the Department license or registration. Employees are notified that copies of the State Materials License and amendments issued to the RSO are available for examination through the RSO.